

[54] **WIRE RECORDING AND MECHANISM THEREFOR**

[75] Inventor: **Robert W. Nordin, Skokie, Ill.**

[73] Assignee: **Teletype Corporation, Skokie, Ill.**

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[51] Int. Cl. **B41j 5/00**

[58] Field of Search **197/1; 234/109, 94, 102; 74/501 R; 101/93**

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Primary Examiner—Edgar S. Burr

Attorney—J. L. Landis and R. P. Miller

[57] **ABSTRACT**

A flexible wire with an input end and an output end extends through an arcuately bent tubular guide that has an input end portion, an output end portion and an arcuate connecting section. The output end portion of the guide is relatively secured. Its input end portion is mounted for movement longitudinally of the guide.

A restraint is arranged about the input end portion of the guide and has a first condition in which said input end portion is secured from moving and a second condition in which the output end portion is free from restraint to permit guide movement.

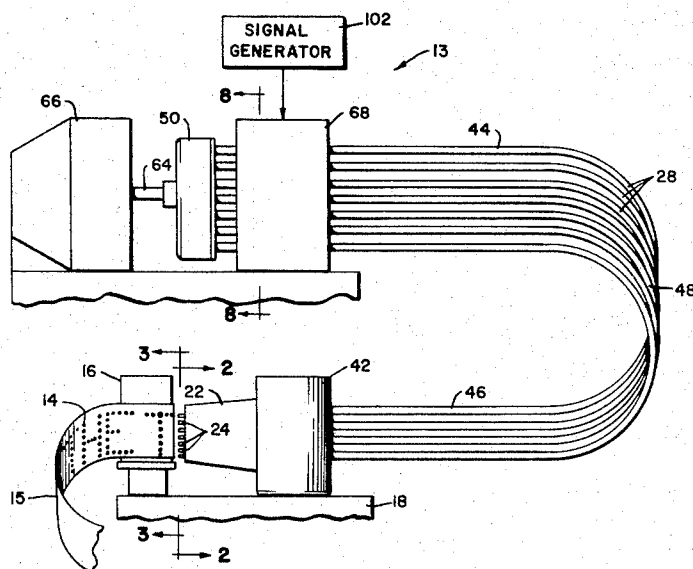
The wire and guide are proportioned such that a force applied to the input end of said wire axially thereof will (1) cause the wire to slide through and thereby project the output end of said wire from the output end portion of the guide, if the restraint is in said first condition; and (2) cause the guide to extend at its arcuate section in a direction away from the output end of said wire in consequence of frictional coupling of the guide and wire, if the restraint is in said second condition.

This switching phenomenon is employed in a recorder having means for applying an oscillating force simultaneously to an input end of each wire in an array of flexible wires which respectively are arranged through arcuately bent flexible tubular guides. The input end portion of each guide is arranged for selective restraint, and release from restraint, in a fixed position such that:

1. when restrained, a rigid path is provided for the associated wire by such guide and, alternately during respective phases of each oscillatory cycle, the output end of the wire will be (a) first projected from the output end portion of the guide into printing position relative a record carrier, and (b) then withdrawn; and
2. when free or released from restraint, alternately during respective phases of each oscillatory cycle, such guide and its associated wire (a) first become frictionally coupled and bend to cause elongation of intermediate portions thereof which are remote from the output end of the wire, thereby to prevent its projection into printing position, and (b) then return to original position.

A character generator produces effects which are representative of the characters to be reproduced. It is coupled to restraining assemblies for the guides, whereby, simultaneously in one phase of each oscillatory cycle, selected wires will be projected for printing and the remaining wires will be prevented from printing.

17 Claims, 12 Drawing Figures



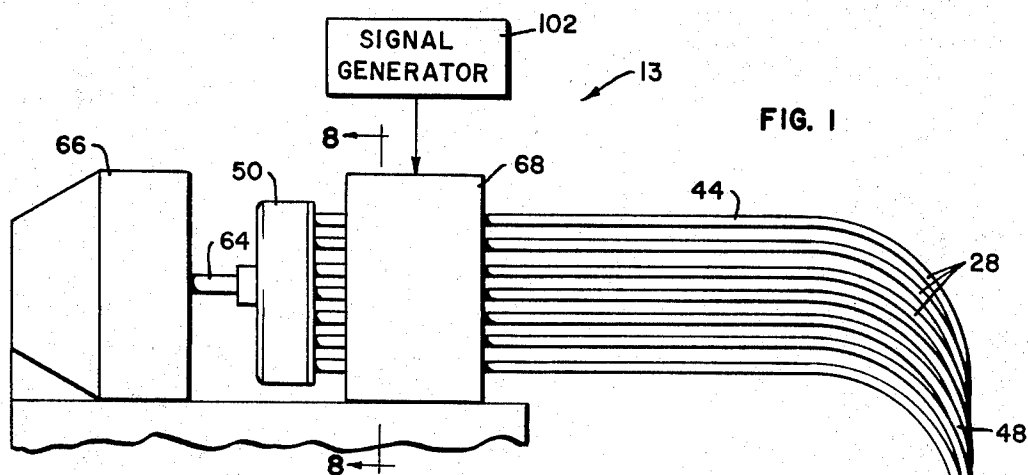


FIG. 1

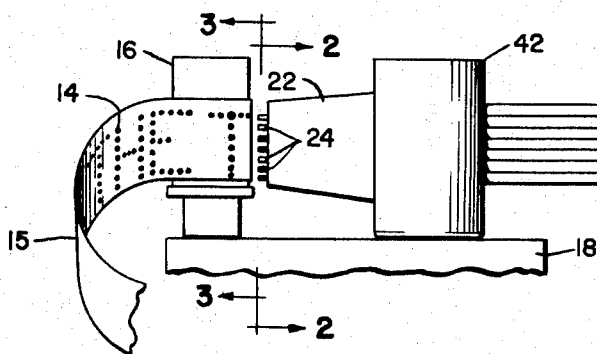
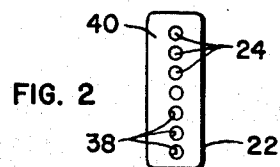


FIG. 2

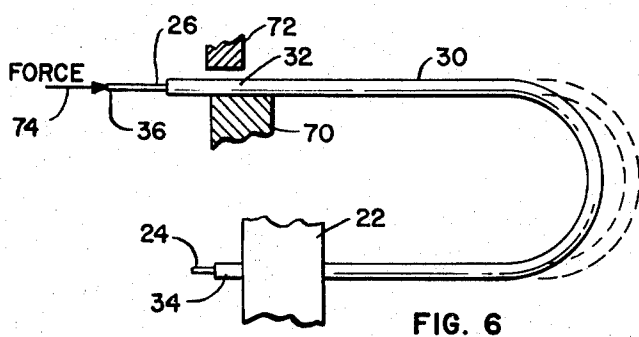


FIG. 4

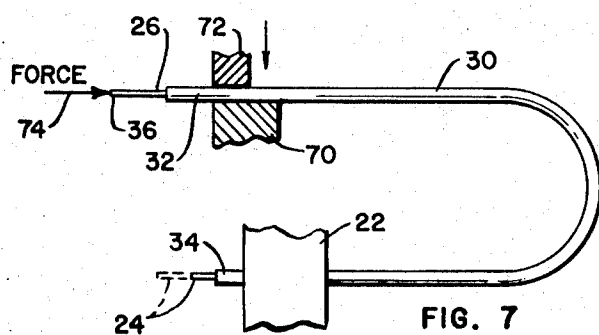


FIG. 5

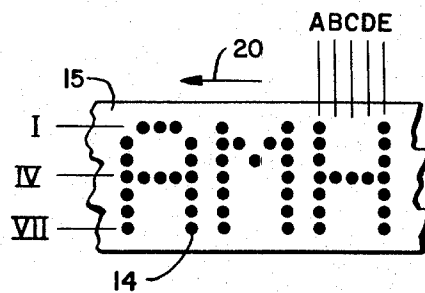


FIG. 6

INVENTOR
ROBERT W. NORDIN
BY *Sherman P. Appel*
ATTORNEY

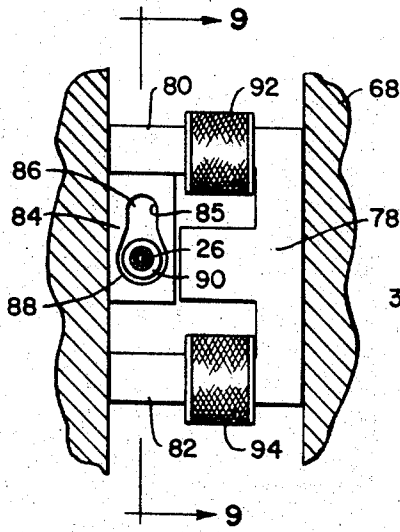


FIG. 8

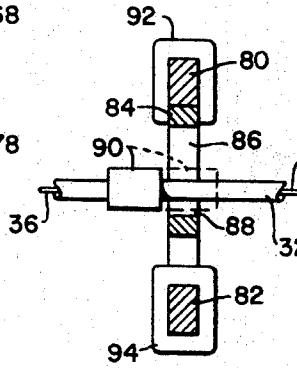


FIG. 9

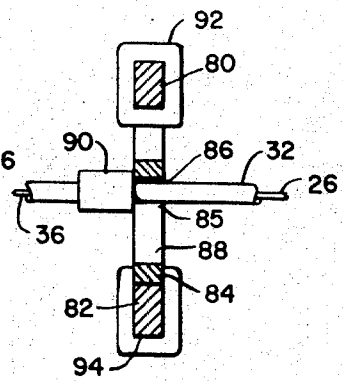


FIG. 10

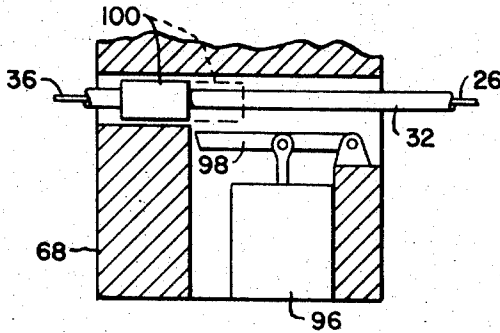


FIG. 11

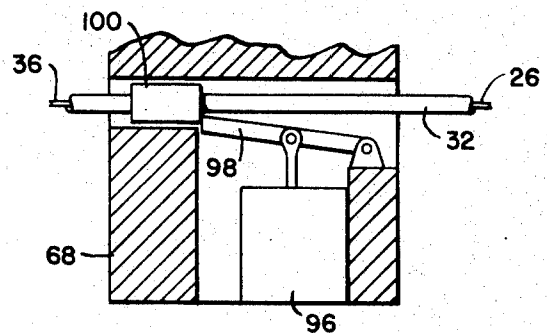


FIG. 12

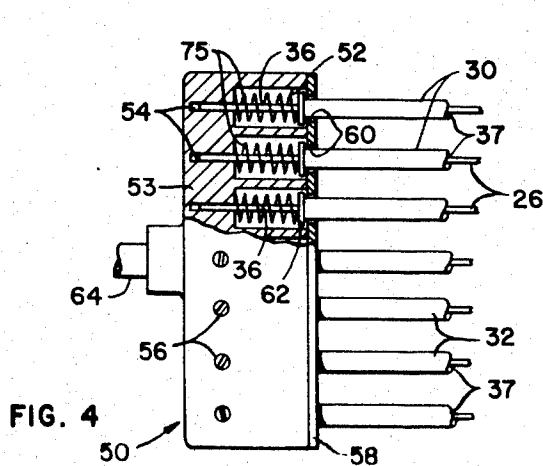


FIG. 4

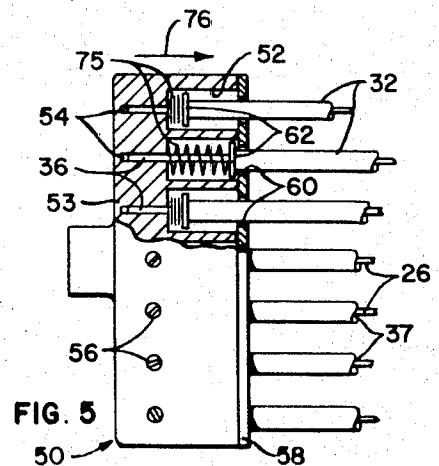


FIG. 5

WIRE RECORDING AND MECHANISM THEREFOR

FIELD OF THE INVENTION

The present invention relates to a shunt. It also relates to wire recording devices and means for wire control. More particularly, the invention relates to printers of the type for reproducing characters which are defined by a dot matrix generated by wires which selectively move from an array thereof into and out of engagement with a recording medium or carrier and to a force control mechanism for selectively operating said wires for printing.

BACKGROUND OF THE INVENTION

In a recorder of the referenced class, print or output ends of wires which may be flexible are held in a print head in fixed relationship with other wires in an array. The head may be stationary and define a fixed station past which translocation means moves a carrier for receiving records; or, the head may be arranged for movement within a limited range, along a track, for example, to successive fixed printing stations. In either event, the wires are recordingly actuated selectively, and in response to electrical effects characteristic of inputs corresponding to the symbols to be recorded.

Limitations on widespread use of recorders, particularly printers, in this art has resulted from two factors, namely, (a) relatively high cost when compared with other types of recorders having similar output capabilities, and (b) slow reproducing speed in comparison to recording devices of other types of similar cost. Both of these deterring factors can be attributed to the character of the means employed for wire control.

It is an object of the present invention to provide a novel recorder.

It is another object of the invention to provide an improved dot matrix printer, particularly wherein an array of wires comprises the printing means.

It is a further object of the invention to minimize the cost of recorders of the referenced type.

It is an additional object of the invention to simplify construction of such recorders.

Moreover, it is an object of the invention to maximize reproduction speed of such recorders.

It is a still further object of the invention to provide novel force control means.

A yet further object of the invention is the provision of a novel shunt.

SUMMARY OF THE INVENTION

To achieve the foregoing, and other objects of the invention which will become apparent from ensuing description, in accordance with the present invention, a flexible wire with an out end segment is arranged for movement through a flexible tubular guide having an outer end portion. A holder which securely supports said end portion has an aperture from which said end segment is projectable. Means are provided for releaseably coupling the wire and the guide to prevent projection of the wire during a projection phase of a force which is applied to the wire and would project the wire if it were not coupled to the guide.

The principle is applied in recording wherein means for reproducing a symbol on a carrier comprises an

array of wires, each of which is adapted for movement axially through a passage in a tubular member between a non-recording position and a recording position. Other means are adapted for driving the wires toward the recording position. While yet other means are provided for restraining from and releasing the tubular members for movement when said wires are driven, for recording with selective of said wires while preventing recording with others thereof.

Considered from another aspect, the foregoing objects are effected in a printing process in which a force proximate end of a wire array is alternated through repeated cycles each of which has a projection phase and a withdrawal phase. A selected flexible first guide for a first of the wires is releaseably gripped to project such wire toward a recording position responsively to the force in one phase of each alternating cycle. Restraint of a second flexible guide for a selected other wire is omitted, thereby, to prevent printing therewith during said phase by coupling together the second guide and said other wire.

BRIEF DESCRIPTION OF THE DRAWINGS

In the ensuing detailed description reference is had to the accompanying drawings in which:

FIG. 1 is a side elevational view of a recorder embodying the present invention;

FIG. 2 is a front elevation of a printing head comprising said recorder, the view being enlarged from the scale of, and viewed as indicated by line 2—2 on, FIG. 1;

FIG. 3 is an elevation of a record carrier in said recorder, enlarged from the scale of, and viewed as indicated by lines 3—3 on, FIG. 1;

FIGS. 4 and 5 are similar enlarged views of a wire mount of said recorder, partially in elevation and partially in section and showing alternate mount conditions;

FIGS. 6 and 7 are similar schemes, alternately conditioned for illustrating the operative principles of the invention;

FIG. 8 is a view of restraining means according to the line 8—8 on FIG. 1 and enlarged therefrom;

FIGS. 9 and 10 are detailed views according to line 9—9 on FIG. 8 and illustrating alternate conditions of said restraining means; and

FIGS. 11 and 12 are detailed views illustrating alternate conditions of another form of restraining means.

DETAILED DESCRIPTION OF THE INVENTION

Referring now more particularly to FIG. 1, shown is a recorder, herein comprising a printer 13 adapted for forming symbols, such as alphanumeric characters 14 on a carrier for records or recording medium 15. A platen 16 projects upwardly from a base 18. It provides a backing member along which carrier 15 is arranged for advancement, in the direction of arrow 20 (FIG. 3), by a suitable drive or motive means (not shown) past a printing head or mount 22 from which the carrier is slightly spaced.

The output or printing ends 24 of an array of flexible wires 26 are printingly supported in printing head 22. Herein, said printing head is shown fixed to base 18; and thereby, it defines a fixed printing station. How-

ever, it is observed that the invention comprehends other arrangements (not shown). For example, the head may be movable along a track, and within a limited range, to successive printing stations disposed longitudinally of a line of characters being printed.

Each of a plurality of Bowden-type, flexible wire assemblies 28 is comprised of an elongated or flexible tubular guide or member 30 with a channel 37 (FIGS. 4 and 5) and an associated wire 26 disposed in said channel. Each guide has an input or drive proximate end portion 32 which is restrainably movable and an output or drive distal end portion 34. Each wire 26 is disposed in an associated guide 30, and, in addition to its printing or output end 24 (heretofore identified), has an input or drive proximate end 36. The input and end of each wire projects beyond the input end portions of its associated guide.

The output end portions 34 of guides 30 are rigidly secured, mounted or fixed to printing head 22. The latter member has a plurality of passages therethrough which are extensions of the channels 37 in said guides. These passages terminate in end apertures 38 (only some of which are numbered in FIG. 2) in the end face 40 through which the output ends 24 of wires 26 are projectable from said head for printing.

Apertures 38 are uniformly spaced, each from an adjoining thereof, and are arranged in a single column shown as vertical. In consequence, only a single vertical column of wire ends 24 are available for printing in exemplary printer 13, though this feature is not intended as limiting on the invention. That is to say, the invention comprehends an array of wires arranged in a head having a plurality of columns of openings (not shown) whereby the complete dot matrix of any alphanumeric character can be printed at one time.

Each exemplary character 14 has a matrix comprised of 35 dot spaces arranged in five vertical, equally spaced apart columns A-E (FIG. 3) and seven equally spaced apart horizontal rows I-VII. Accordingly, using printer 13, successive columns A-E of dots will be printed in a succession of five cycles during phases of each cycle in which the printer is in a print mode.

Ink supplying means in apparatus 13 comprises an ink reservoir 42. It is disposed adjacent head 22 about a medial portion of wire assemblies 28 such that ink is continuously supplied to output ends 24 for printing. The combination of reservoir 42 with assemblies 28 may be according to the disclosure of a contemporaneously filed application, Ser. No. 73,939, of the inventor in the present application and Charles R. Winston, and assigned to the assignee of the present application. It is not intended, however, that this invention be limited to such ink supplying means. As it is within the technical capability of this art to provide, as a printing medium, a hot melt type ink on the surface of transfer paper (not shown) interposed between the wire output ends and carrier 15, such that the dot matrix of each printed character will be formed by driving the transfer paper against the carrier with selected output ends.

Each assembly 28 is U-shaped, the assemblies being arranged in a straight, first, input or upper course 44 and an opposed straight, second, lower or output course 46 with a curved medial connecting section 48. The drive proximate end of course 44 comprises input end portions 32 of the guides and input ends 36 of the

wires. Course 46 includes output end portions 34 of the guides and the output ends 24 of the wires. In course 44 and connecting section 48 each assembly 28 is separated from the others thereof. However, proximate reservoir 42 each guide in course 46 may be secured, for example by fusion, to an adjoining thereof.

A holder or mount 50 (FIGS. 1, 4 and 5) comprises mounting means for the drive proximate end of course 44; and said mount is arranged in any suitable fashion for oscillation or reciprocation in a straight path, herein shown as horizontal. The holder has a plurality of discrete forwardly opening wells 52, each thereof associated with one of the assemblies 28. Each well has a bore 54 of smaller diameter in the rear wall 53 of the mount. The input end 36 of an associated wire is adjustably secured in a corresponding bore by a suitable fastener, such as a set screw 56, so that the input ends 36 of all of the print wires 26 will move simultaneously with mount 50.

A cover plate 58 is secured over wells 52 as a front face for mount 50. It has an aperture 60 associated and aligned with each well 52. Each of said apertures is of smaller dimension than its associated well to restrict opening of the latter to the exterior. Each aperture is proportioned to slidably pass the end portion 32 of a corresponding guide 28 with its wire 26 therein. A flange or annular boss 62 is secured on or integral with the free end of each input end portion 32 and is disposed in an associated well 52. It is proportioned for movement longitudinally of such well and to engage the back surface of cover 58 about the periphery of an associated aperture 60. Thereby, no guide 30 can be wholly withdrawn from mount 50.

Each wire 26 may be of metal fabrication and has a cross sectional dimension such that it is movable longitudinally within its associated guide, independently thereof, when the input end portion 32 of the latter is rigidly held (FIG. 7). Thereby, the output end 24 of each wire can be projected into and withdrawn from a printing position (dashed lines in FIG. 7). Each channel 37 is proportioned such that a wire therein frictionally engages its guide and, in consequence of such coupling, independent movement of wire and guide is precluded when an end portion 32 is free of restraint (FIG. 6). Thereby, projection of any end 24 from head 22 can be prevented. The foregoing features are relied upon to cause printing in accordance with the present invention.

A horizontally extending tie rod 64 has one end rigidly secured to mount 50. It is connected at its opposite end to any suitable alternating oscillatory or reciprocative drive or means 66 for applying an oscillatory force of fixed frequency and amplitude to the mount and thereby to input ends 36. Each cycle of the drive has a first or projecting phase during which printer 13 is in a printing phase and the end 24 of a wire selected for printing is driven from a place of beginning to printing mode, and a second, return or withdrawal phase. Depending upon whether a guide 30 is restrained or free of restraint, in a manner hereinafter to become apparent, such guide and its wire will have a printing condition (FIG. 7) or a non-printing condition (FIG. 6), while the printer is in a printing phase. During the return phase of each cycle all parts of the printer which have moved are restored to their conditions of beginning.

When a guide and its wire are in a non-printing condition during the printing phase of the printer, such guide and its wire will be termed "extended". Such "extension" is not to be confused with "projection" of ends 24. As used herein, "projection" refers to the relative movement of an output end 24 into a print mode (dashed line in FIG. 7) from its normal or beginning position (solid line in FIG. 7) relative end portion 34. "Extension", on the other hand, is defined as the condition in which a wire and its guide are elongated (dashed line of FIG. 6) distally from head 22 from a normal or beginning position (solid line of FIG. 6) in consequence of frictional coupling thereof during the projection phase of the printer.

Means 68 for restraining, holding, immobilizing, clutching, or rigidly securing guides 30, particularly input end portions 32, is mounted adjacent mount 50. Said restraining means comprises a plurality of restraints or restraining assemblies, one being mounted in association with each assembly 28 in the housing for said restraining means. In FIGS. 6 and 7, wherein the operative principle of the invention is illustrated, a restraint is shown as a simple clamp having a lower fixed jaw 70 and an upper movable or opposable jaw 72. Each restraint has a non-print position (FIG. 6) and a print position (FIG. 7) between which said jaws are relatively movable.

When a restraint is in its non-print position, associated guide 30, particularly its input end portion 32, is free from restraint or movable such that the force of drive 66 during its projection phase, that is, in the direction of arrow 74, will cause shunting of the drive force and extension of said guide and its wire from the solid line position to the dotted line position of FIG. 6. This phenomenon results from transmission of drive force from such wire to its guide through the agency of frictional coupling therebetween, the resistance of such guide to extension being insufficient to overcome the force of the drive on the wire and consequently yielding thereto. Accordingly, the corresponding output end 24 is prevented from moving from non-print to its print mode during the projection phase of said drive. During the return phase of the drive cycle (in a direction opposite to arrow 74), an unrestrained guide and its wire will be restored to the solid line position (FIG. 6) by return movement of the clamped wire ends 36 with the mount 50.

When the restraint is in its print position, its associated guide 30, particularly its input end portion 32, is restrained, held, immobilized or secured such that a rigid path is formed through such guide. In such condition, drive force in the direction of arrow 74 is sufficient to overcome frictional coupling. In consequence the drive force will be shunted to cause the associated wire to slide in its guide, its end 24 being projected into a printing condition from its normal non-printing condition. Upon application of force in the second phase of a drive cycle (opposite the direction of arrow 74), the clamped wire will be restored from its printing to its non-printing condition.

The parts are proportioned and arranged such that at the beginning of a projection phase of each oscillatory cycle of mount 50 (FIG. 4), each flange 62 is engaged with the rear face of cover 58 and a corresponding abutment 75. During such phase, as said mount moves in the direction of arrow 76 (FIG. 5), end portions 32

of guides which are restrained proximate the mount will enter further into the body of the mount through apertures 60 such that their flanges 62 will move into wells 52 and away from plate 58. The movement of mount 50, to which the wire input ends 36 are clamped, will cause projection of output end portions 24 associated with such restrained guides. Simultaneously, end portions 32 which are not restrained will move with said mount because of their frictional coupling with their wires, and their flanges 62 remain engaged with the rear surface of plate 58. Accordingly, such last wires will not be projected and will not print.

An alternate restraint shown in FIGS. 8-10 comprises a solenoid 78 which includes an E-shaped magnetic core of soft iron with a pair of opposed legs 80 and 82. A magnetically shiftable latch 84 is controlled by solenoid 78 and has an aperture 85 through which end portion 32 of an associated assembly 28 extends. Said aperture has a reduced section 86 and a wide section 88. To position the latch selectively, it is arranged for movement in response to an induced magnetic field generated by appropriate effects through electrical coils 92 and 94 mounted respectively about legs 80 and 82.

Aperture section 88 is proportioned to accommodate sliding movement therethrough of its guide and a catch 90 in the form of a sleeve rigidly secured thereon. When the latch is adjusted to enable such movement (FIGS. 8 and 9), it is in a non-latching condition and its guide is free from restraint such that its wire will not print when the drive is in a projection phase.

Narrow aperture portion 86 is proportioned such that it will prevent movement of catch 90 therethrough. When the latch is adjusted to prevent movement (FIG. 10), its guide is restrained and output end 24 of its wire will be projected for printing when the drive is in a projection phase.

Alternate restraint of FIGS. 11 and 12 comprises a solenoid 96 associated with each assembly 28. The solenoid is arranged for selectively rocking a latch or arm 98 between a first position (FIG. 11) in which its associated end portion 32 will not be restrained and a second position (FIG. 12) in which said end portion 32 will be restrained. To that end, each guide has a catch 100 formed as a sleeve secured thereabout which is arranged for movement between the solid and dashed line positions of FIG. 11. The parts are proportioned, however, such that latch 98, when in its second position is in the path of movement of catch 100 for latching therewith and for preventing its guide from moving.

An embodiment of the printer 13 having an alternate restraint of the type shown in FIGS. 8-12 may require a stop to prevent a guide 30 which has been restrained from following the mount when the drive is in a return phase. To that end a compression spring 75 may be mounted about input end 36 of each wire with the opposite ends of each spring bearing against rear wall 53 of mount 50 and an associated flange 62. Equivalently, a stop (not shown) within each wall 52 and fixed to ground such that it is movable relative mount 50, can be arranged in engagement with an associated flange. Thereby, as mount 50 is returned, an associated guide 30 which has been restrained will move relative said mount to its place of beginning.

Any known means defining a signal generator 102 (FIG. 1) may be arranged for electrically controlling restraining means 68. That is to say, the signal generator comprises circuitry which produces an output effect corresponding to the characters 14 to be reproduced on carrier 15, such effect being characteristic of an input corresponding to the characters to be reproduced, the restraints being responsive to said output whereby they will be moved to selected of their modes in consequence of which selected wires 26 will be prevented from printing or will be printably driven.

An operable device according to the invention has a drive which oscillates at about 300 cycles per second. This will produce printed alphanumeric characters with a matrix of 35 dots at the rate of about 40 per second. Steel as the fabric of wires 26 with a diameter of 0.014 inch and flexible polytetrafluoroethylene guides 30 having an interior diameter of 0.015 inch and an exterior diameter of 0.033 inch provide satisfactory assemblies 28.

The mechanical shunt comprised of a Bowden-type wire assembly 28 and an associated restraining means 68 enables minimization of cost in wire printers to a level which encourages production for commercial sale. The operating principle, however, is not limited to wire control in a printer; and various other uses of the shunt within the scope of the invention will suggest themselves. That is to say, another utilizing device (not shown) could be associated with and controlled by an output end 24 as it moves between its alternate positions (FIG. 7). Furthermore, the force of extension (dashed line of FIG. 6) could also be used. For example, a utilizing instrumentality (not shown) could well be arranged for actuation or control as a result of movement of an assembly 28 between its normal position (solid line of FIG. 6) and its extended position (dashed line of FIG. 6).

As many modifications in the described construction and process could be conceived, and as many changes could be made therein without departing from the spirit and scope of the claims, it is intended that all matter contained in the accompanying specification shall be considered as illustrative only and not in a limiting sense.

I claim:

1. A recorder for forming a symbol on a carrier and comprising:

An array of flexible tubes;

an array of flexible wires, each arranged for reciprocative movement axially through one of said tubes and between a non-recording position and a projected recording position;

means for applying an alternating driving force on each of said wires, each alternation and said applying means having a projection phase for recording and a return phase; and

means for simultaneously restraining some and omitting restraint from others of said tubes with said applying means in a projection phase for recording with selected of said wires while preventing recording with others thereof.

2. A combination according to claim 1 wherein each of said tubes, with restraint omitted, and its associated wire are frictionally coupled together for preventing recording when said applying means is in a projection phase.

3. A combination according to claim 2 wherein said tubes with restraint omitted and associated wires have an extended condition medially of their ends when said applying means is in a projection phase.

4. A combination according to claim 1 wherein said applying means comprises a holder, said wires having parts rigidly secured from said holder for reciprocation in response thereto.

5. A combination according to claim 4 wherein restrained ones of said tubes have input portions slideable in said holder relative to associated wires.

6. A combination according to claim 5 wherein each tube has a medial bent portion arranged for movement, a coupled condition in frictional engagement with and for preventing movement of an associated wire independently of such tube and into printing position, and an uncoupled condition enabling movement of such wire independently through such tube for printing, said combination further comprising a boss secured to each input portion for limiting movement of said tubes from said holder when said tubes are in coupled condition.

7. A combination according to claim 4 wherein said restraining means comprises a solenoid and an element responsive thereto in association with each tube.

8. A combination according to claim 4 wherein the restraining means comprises a clamp, having a pair of opposed relatively moveable jaws, arranged for releaseably gripping each tube.

9. A combination according to claim 7 wherein said element comprises a moveable latch disposed about an associated tube and having an aperture with a narrow section and a wide section, said solenoid having a printing condition in which said guide is restrainedly disposed through said narrow section and a non-print condition in which said tube is moveably disposed through said wide section.

10. A combination according to claim 9 characterized by a collar secured about said tube and having a diameter less than the width of said wide section and greater than said narrow section for selectively preventing and permitting movement of said tube through said clamp to couple and release said guide and its wire.

11. A combination according to claim 7 characterized by a catch secured to each tube and wherein each element is a latch arranged for releaseable engagement with said catch.

12. A printing process wherein selected wires from a wire array are projected through guides into recording position and comprising the steps of:

continuously applying an alternating force on an input portion of each wire in the array, each alternation being a cycle having a projection phase and a return phase;

releaseably gripping selected guides and projecting therefrom output end portions of selected wires in response to the force in a projection phase of one of said cycles; and

preventing projection of output end portions of the other wires from said other guides during said last projection phase by omitting to grip said last guides.

13. A printing process according to claim 12 further comprising frictionally coupling said other guides and said other wires together for preventing independent relative movement thereof and precluding printing with such other wires during a projection phase.

14. A printing process according to claim 13 wherein a medial portion of each of said other guides and a medial portion of each of said other wires are extended away from their opposite ends as the force is applied during said projection phase.

15. In a printer of the type wherein printing means include a plurality of flexible tubular guides, each guide having an apertured input end portion and an apertured output end portion, a flexible wire disposed in each guide for movement axially thereof and having an input segment and an output segment, and means for immobilizing said output end portions, the improvement comprising:

a selectively operable restraint disposed adjacent to each guide for holding some input end portions while omitting to hold other input end portions;

a holder secured to said input end segments, each input end portion arranged in said holder for sliding relative thereto and about an associated wire when a corresponding restraint is holding and for moving together with said holder when a corresponding restraint is not holding;

means for applying an oscillating driving force on said holder, said holder having a projection phase in which a projecting force is applied to said wires

simultaneously and a return phase in which a withdrawing force is applied to said wires simultaneously; and

means for selectively actuating said restraints for holding some of said input end portions to project for printing corresponding output end segments during said projection phase and for omitting hold on others of said end portions to fail to project others of said output end segments during said projection phase.

16. A combination according to claim 15 further comprised of a boss secured to each input end portion for limiting movement of a corresponding guide from said holder during said projection phase when hold thereon by a corresponding restraint is omitted.

17. A combination according to claim 16 further comprising means in said holder for yieldably resisting movement of each input end portion into said holder and having a first condition in which part of such input end portion is projected from said holder during a projection phase and a second condition in which such input end portion part is forced into said holder against said resisting means during a projection phase.

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